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THE EFFECTS OF POLLUTION CONTROL ON THE NONFERROUS METALS INDUSTRIES

LEAD

Part I

Introduction and Executive Summary

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CHARLES RIVER ASSOCIATES INCORPORATED · CAMBRIDGE, MASSACHUSETTS

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CHARLES RIVER ASSOCIATES INCORPORATED

THE ECONOMIC EFFECTS OF POLLUTION CONTROLS ON THE NONFERROUS METALS INDUSTRY: LEAD

Prepared for
the Council on Environmental Quality

Prepared by
Charles River Associates Incorporated
16 Garden Street
Cambridge, Massachusetts 02138

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TABLE OF CONTENTS

Preface i

Part I

Chapter 1 -- INTRODUCTION AND EXECUTIVE SUMMARY. . . 1

Overview of the Lead Market 1

Technology of Production. 2

Demand for Lead 4

Prices in the Lead Industry 7

Structure of the Lead Industry. 8

Government Policies 12

The Lead Industry in the United States. 13

The Economic Effects of Pollution Control on the Lead Market. 18

Pollution Control Costs 18

Effect of Pollution Controls on the Lead Industry. 19

Part II

Chapter 2 -- TRENDS IN SUPPLY AND TECHNOLOGY OF LEAD PRODUCTION. 22

Lead Ore. 24

Reserves of Ore 26

Mining. 26

Mining Costs. 27

Milling 28

Smelting and Refining 28

Pollution Aspects of Lead Smelting and Refining 29

Smelting and Refining Costs 30

Chapter 3 -- CONSUMPTION OF LEAD 31

Storage Batteries 35

Gasoline Additives. 37

Lead Cable Sheathing. 39

TABLE OF CONTENTS (Continued)

Paints and Pigments. 40
Construction 41
Durable Manufactures and Final Goods 41
Summary. 42

Chapter 4 -- STRUCTURE OF THE LEAD INDUSTRY 43
Primary and Secondary Markets. 43
Imports. 45
Prices and Competition 46
Integration and Concentration. 47
Trends 51

Chapter 5 -- PRICES IN THE LEAD INDUSTRY. 53
Price History. 55
Analysis of Lead Prices. 57

Chapter 6 -- GOVERNMENT POLICIES IN THE LEAD INDUSTRY 60
Stockpiling. 60
Tariffs and Surcharge. 61
Price Freeze 63
Other Policies 63

Chapter 7 -- THE LEAD INDUSTRY IN THE UNITED STATES. 65
Ores and Mines 65
Employment and Labor Productivity in Lead Mining 68
Leading Domestic Lead Mining Companies 69
Smelting and Refining. 70
Secondary Producers. 70
Primary Producers. 71
ASARCO 72

TABLE OF CONTENTS (Continued)

Bunker Hill. 76
AMAX 77
St. Joe. 77
Anaconda 78
Smelter Summary. 78
Financial Data 79
Analysis of the Cost and Profitability of Lead and Zinc Production in the United States 83
Calculation of Costs 84
Summary. 91

PART III

Chapter 8 -- ECONOMIC EFFECTS OF POLLUTION CONTROLS 92
Cost Estimates 92
Probable Trends in the Lead Market in the Absence of Pollution Controls 96
The Effects of Pollution Abatement Costs 101
Effects on Price 107
Other Effects 110

PREFACE

This report on the economic effects of pollution controls on the lead industry has been organized into three parts comprised of eight chapters. The three parts can be read separately or in conjunction with one another. Part I summarizes the contents of the succeeding two parts, providing a broad profile of the lead industry and outlining the economic effects of pollution controls on the industry. The important points and conclusions of the full report are contained in the first part, with greater detail and analysis in the following two parts.

Part II comprises separate chapters on:

Trends in supply and the technology of production
Consumption
Structure of the industry
Prices
Government policies
The lead industry in the United States

Part III is our detailed analysis of the economic effects of imposing pollution controls on on the lead industry.

Much of the information contained here was first published in Charles River Associates Incorporated, *An Economic Analysis of the Lead-Zinc Industry* (Cambridge, Mass., 1967, revised 1969), which we prepared under contract with the General Services Administration. Data presented in this report if not otherwise attributed is taken from our GSA report.

PART I

Chapter 1

INTRODUCTION AND EXECUTIVE SUMMARY

Overview of the Lead Market

The lead market has shown little growth over the past three decades, and U.S. consumption of lead has lagged behind growth in the rest of the world. The U.S. average annual rate of growth has been about 1 percent per year, and about 3.6 percent for the non-communist world as a whole.

Lead is used predominantly as an input in the production of other commodities. The major consumers of lead are the storage battery manufacturers, for starting, lighting, and ignition batteries, and the petroleum refiners, for anti-knock additives for gasoline. Both of these consumption categories have demonstrated strong and persistent growth, but the general expectation of both producers and users is that the market for leaded gasoline additives will dwindle and eventually disappear. Storage batteries accounted for over 40 percent of U.S. consumption in 1970 and

gasoline additives for about 20 percent. The remaining uses -- paints, plumbing, soldering, and cable coverings -- have been subject to long-term technological displacement by other materials. In recent years producers have cooperated to sponsor research for new products and to increase marketing efforts.

Technology of Production

Lead occurs in ores which vary considerably in lead content and other recoverable metals such as zinc, copper, and silver. Galena (lead sulfide) is the most commonly found lead mineral. In the eastern United States the mineral is high in zinc content, with lead being a by-product. In the central states a higher lead content is common, and in the western states several minerals are generally found in coproduct proportions. Lead mineral deposits throughout the world may be similarly characterized.

There are generally four stages in the transformation of lead into commercial metal: mining, milling, smelting, and refining. Mining and milling are performed in close proximity to one another, and both are much more widely scattered than smelting and refining.

Most of the world's lead ores are extracted from underground mines. Milling is the process of separating the mined ore into concentrates, and is considered integral to the mining operation.

Lead mines give rise to relatively minor environmental problems. Not much land surface area is required,

and mine locations are generally remote. Most mine wastes are either commercially utilized or returned to the mine. Dust emission is relatively easily controlled.

The level of costs varies considerably among individual mining and milling establishments, but the behavior of unit costs can be represented in a general fashion. The typical mining company has a large proportion of fixed costs, sharply increasing short-run unit costs, and roughly constant average costs both for moderate changes in intermediate term output and for substantial changes in long-run output. The intermediate term refers in this case to a period of one or two years during which additional skilled workers and specialized heavy mining equipment can be acquired and new excavations in existing mining areas can be prepared. For decreases in output, the large fixed cost component -- roughly one-third of total intermediate term costs -- imposes sharply rising costs.

The lead concentrates produced at the mills are smelted to yield bullion and matte. Smelting has two stages: roasting (or sintering) and reduction. In the roasting stage, the lead concentrate is oxidized to yield lead oxide in sinter form and gaseous sulfur dioxide. The sinter is then reduced, most often by a blast furnace. The resulting lead bullion usually contains a number of valuable coproducts and deleterious impurities. To separate these, the bullion is further treated by a series of procedures collectively referred to as refining. Most major lead metal producers locate their smelter and refinery at the same site, though

some ship the smelted bullion considerable distances to refineries.

The major waste problem is the emission of sulfur dioxide which occurs in the roasting (or sintering) stage of the smelting process. Other dust and gaseous emissions are relatively easily controlled. The sulfur dioxide may also be captured relatively easily from a technological point of view by means of an acid plant which then produces sulfuric acid. However, the sulfur content of the lead concentrate may be quite low, which results in high costs for the acid plant. These issues are considered in detail in Chapter 8 of this report.

Smelting and refining costs account for about one-third of total lead mining and refining costs, with about two-thirds of the cost going to the acquisition of lead concentrates. Of the smelting and refining costs, roughly one-third may be regarded as fixed in the intermediate term. Thus decreases in output are likely to impose as sharply rising average costs on refineries as on mining companies. Short-run output increases in refining are probably attainable at smaller cost increases than in mining. Long-run average costs are roughly constant for plants large enough to achieve economies of scale, which appear to be from about 80,000 to 200,000 tons of refined lead per year.

Demand for Lead

Lead is used predominantly as an input in the production of other commodities, and in most of its intermediate uses the cost of lead is a small proportion

of the total costs of the final products in which it is embodied.

DOMESTIC LEAD CONSUMPTION CLASSIFIED BY END USE
1960, 1969, 1970
(In Short Tons and as a Percentage of U.S. Total)

End Use	1960		1969		1970	
Storage Batteries	353,200	(34.59)	582,546	(41.93)	569,741	(42.55)
Petroleum Refineries	163,800	(16.04)	271,128	(19.51)	278,505	(20.80)
Paints and Pigments	100,300	(9.82	103,969	(7.48)	98,906	(7.39)
Construction	115,200	(11.28)	90,082	(6.48)	67,094	(5.01)
Durable Manufactures	147,800	(14.48)	170,053	(12.24)	132,146	(9.87)
Final Goods	80,400	(7.87)	117,377	(8.45)	100,368	(7.50)
Cable Coverings	60,350	(5.91)	54,203	(3.90)	50,295	(3.76)
Estimated Unreported Consumption	--		--		42,000	(3.13)
Total	1,021,050		1,389,358		1,339,100	

SOURCE: *Yearbooks* of the American Bureau of Metal Statistics. (The grouping of ABMS data into end uses is described in the text.)

For some uses, including the two major uses which constitute about 60 percent of total lead consumption, no close substitutes are readily available. This appears to be true also in the short or intermediate run for most remaining uses. Consequently, the demand for lead is generally insensitive to changes in its price, at least for an intermediate term of perhaps several years. It remains true, of course, that the longer-run technological displacement of lead by other materials has been induced in the main by the relative price of lead, and when technological breakthrough occurs, displacement can take place rapidly. Such was the case in replacement of lead by plastic and aluminum in many cable coverings in the late 1950's. There is a strong possibility that use of lead in gasoline will be phased out within the coming decade, although the issue is by no means settled. This will be a result of regulation for environmental purposes rather

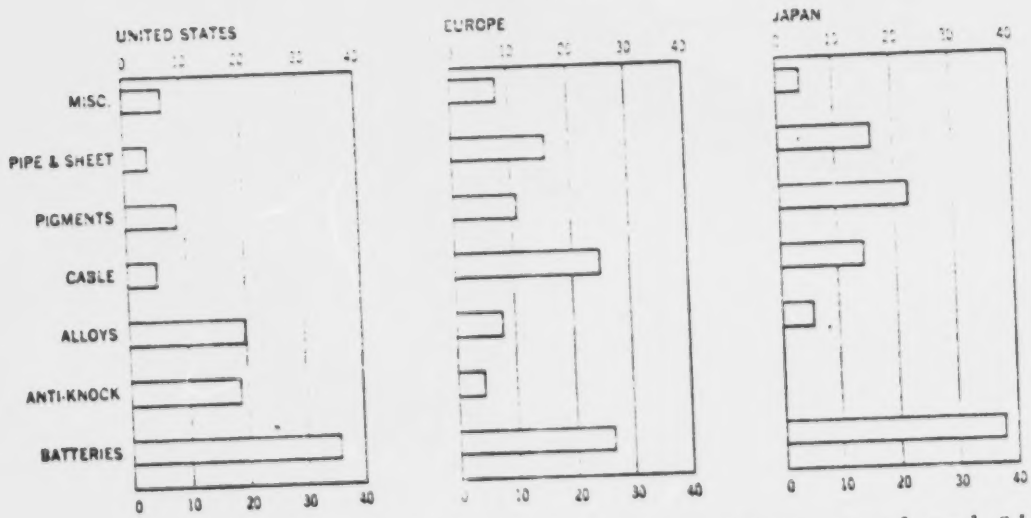
than a response to a change in the price of lead. This sector of the market may experience a decline of about 40 percent by 1975 and of about 10 percent per year from then until 1980. The effect of this is likely to be a reduction in the rate of growth of lead consumption by about 0.5 percent over the decade, but in absolute terms the tonnage lost in the gasoline market is likely to be more than offset by the normal tonnage gains in the battery market.

Total U.S. consumption has grown slowly in the United States and only slightly faster abroad. Foreign consumption patterns also differ from those in the United States. In Europe and Japan, the other major consumption regions, relatively greater shares of total consumption are taken by pipe and sheet, pigments and cable coverings, and smaller shares by alloys and anti-knock gasoline additives. Neither the faster growth nor the different composition of foreign consumption has induced a substantial export effort by the United States. Total U.S. lead metal exports in 1970 were 7,700 tons, or 0.4 percent of total U.S. supply. On the other hand, imports of metal were 244,600 tons, or 14.4 percent of total U.S. supply.

LEAD

END USE CONSUMPTION PATTERNS 1968

Per Cent of Total



REPRINTED FROM: Lead Industries Association, *Lead and Zinc: Free World Demand and Supply* (April, 1968) p. 11.

Prices in the Lead Industry

The two basic prices of lead are the New York producers' price which applies to the United States, and the London Metal Exchange (LME) price which applies to the rest of the world. There are other prices that apply to local markets and sometimes deviate from the LME and New York prices, but not for substantial time periods or for large transactions. The price is for common grade lead.

The difference between the LME and New York prices has generally been within a range determined by tariff and other import costs, though exceptions to this can be found. At times it appears that the LME price follows the New York price, but on other occasions the reverse pattern is evident.

Both the LME and the New York prices have fluctuated considerably, the former more than the latter. Although there is no formal control over price nor an established U.S. price leader, there have been periods of greater stability, and more instances of parallel changes in domestic and foreign prices, than can be explained by market prices and government policies alone. During the rather lengthy periods in which prices have been stable, the price has been the same for all domestic producers. The U.S. price has behaved as an administered price upon which the lower cost producers have dominant influence.

The evidence presented in Chapter 5 of this report indicates that over the long run the real price of lead has been closely related to long-term unit costs, which were fairly constant in real terms until the late 1960's. Since 1968 there appears to have been a significant decline in costs for a substantial portion of the industry. Concentration in the market appears to have allowed the price to stand at a higher margin over costs than would be the case in a purely competitive market, though foreign competition, and perhaps potential entry, have placed narrow limits on such a margin.

A frequent cause of periodic breaks in the New York price has been rising inventories associated with the general business cycle or other sharp drop-offs in demand. Periods of high and rising inventories, 1970 for example, have been associated with falling prices. The current lead price is under pressure both from that phenomena and from the unusually sharp increase in capacity since 1968 from the new Missouri operations.

Structure of the Lead Industry

Lead is marketed both as a concentrate and as refined pig or alloy. Because about half the world's concentrate production is carried on by integrated firms and does not reach the market, our discussion of price and output focuses on the market for refined lead.

For some purposes it is important to distinguish between primary and secondary lead products. Of the 1970 total domestic supply of lead metal, primary producers accounted for about 40 percent and secondary producers contributed about 31 percent. Suppliers of secondary products differ from suppliers of primary products with respect to production costs, raw materials sources, entry conditions, scale of operations and concentration. The main cost to secondary producers is the price of scrap lead. New scrap lead is generated from the production of lead, and old scrap is reclaimed from discarded lead products. Old scrap accounts for about 85 percent of total scrap supply, and storage batteries account for about 75 percent of old scrap.

Entry into the secondary market is easier than into the primary market, as access to secondary raw materials (scrap lead) is much easier than access to primary raw materials (mined lead), and the time horizon for entry or capacity adjustment is shorter for the secondary than for the primary sector. The secondary lead market is much less concentrated than is the primary sector, and the scale of operations of a secondary producer is typically very small relative to that of a primary producer. Nearly 150 U.S. companies reported some secondary production in 1969, whereas six major primary lead refining companies produce essentially all domestic primary refined lead in 1971. One of the smaller producers will cease its operations at the end of 1971. Of all domestic refined lead, primary refineries account for about 75 percent. Secondary producers contribute about 90 percent of antimonial lead output and nearly all of the remaining lead alloy output. The share of secondary producers in U.S. consumption of lead has remained roughly constant over the past decade. As the supply of secondary lead is closely tied to past consumption, it is insensitive to the price of lead except perhaps in the short run.

COMPOSITION AND DISPOSITION OF
U.S. SUPPLY OF LEAD, 1970

(Thousands of Short Tons)

Components of U.S. Supply (and % of Total)	Disposition of Supply (and % of Total)
U.S. Primary Production 680.2 (39.8%)	U.S. Consumption 373.5 (80.5%)
Imports of Metal 244.6 (14.4%)	Industry STocks 325.8 (19.1%)
Secondary Metal 536.4 (31.4%)	Exports 7.7 (0.4%)
Industry Stocks 245.8 (14.4%)	

After primary and secondary production, imports are the third largest contributor to domestic supply, accounting for 14.4 percent in 1970. The share of imports in total U.S. consumption varied between 20 and 25 percent over the 1960-1969 period, and has dropped off to 18 percent in 1970 and about 15 percent from January through July, 1971. It appears that the new Missouri production since 1969 is contributing most importantly to this import displacement. The major exporters of lead to the United States are Canada, Australia, Mexico, and Peru.

Although there seem to be substantial international competitive pressures, national market structures vary. In France production is carried on under practically monopolistic conditions. Competitive forces in tne United States appear to be much stronger, although the market is concentrated. The geographic scope for competition in lead lies somewhere between the two extremes of a national market subject to peripheral import competition and a cohesive world market where economic and political barriers are negligible.

The U.S. lead industry contains both integrated and nonintegrated producers, with the latter including independent mining firms and custom smelters and refiners. The integrated firms own mines and mills as well as smelting and refining plants. The greatest part of their lead output is refined from concentrates produced by their own mines and mills. Custom smelters purchase lead concentrates from other foreign or domestic companies and either smelt or refine or both. The distinction between custom refiners and independent

producers is not absolute, as some custom refiners own mines and integrated firms do some custom work.

Refining is a more concentrated activity than is mining, both in the United States and abroad. Integrated domestic producers account for about 85 percent of total U.S. primary and secondary refined lead, and from 55 to 60 percent of total U.S. output of mined lead. In the noncommunist world, the primary capacity of integrated primary producers accounts for 70 to 75 percent of world production. In world mining, integrated primary producers contribute about 50 percent of mine production. Secondary lead involves a much lower degree of integration than does the primary sector.

An indicator of the degree of concentration is world concentration in primary lead refinery capacity. In our 1969 report to GSA, we indicated that the top four firms' refining capacity accounted for over 40 percent of the total noncommunist world production. The top eight firms accounted for nearly 60 percent, and the top 20 firms for nearly 90 percent. Domestically, the top four firms accounted for 64 percent of the value of shipments of refined lead, and the top eight firms accounted for about 73 percent. It appears that the U.S. industry is becoming increasingly concentrated, and that U.S. producers will increase their share of the domestic market at the expense of imports. Both of these trends are attributable in large part to the impact of the introduction of large low cost ore reserves in Missouri.

Government Policies

The most important policies that affect the lead market are the import tariff and surcharge, the price freeze, and stockpiling.

The level of the tariff from 1965 to August, 1971 was $0.075 per pound on lead ores and $0.010625 per pound on metal. The statutory rates dating from 1930 on these items are $0.015 and $0.02125 per pound, respectively. The statutory rate is the maximum rate applicable. The actual rate will be lower if the pre-August tariff plus 10 percent of the foreign invoice value of the import is less than the statutory rate. As of October, 1971, the London Metal Exchange price of lead was about $0.101 to 0.103 cents per pound. The tariff then applying should be $0.03075 to 0.020925 per pound. If another $0.01 to 0.0125 is added for freight and delivery charges, foreign lead would be currently available at $0.132 to 0.136 per pound. Such a price would represent a substantial discount from the October average domestic producers' price of slightly more than $0.14 per pound. However, the foreign price is temporarily depressed by the U.S. East Coast dock strike which is causing supplies to accumulate abroad. After the dock strike the domestic and foreign price should come back into closer alignment. It is important to note that the LME price quickly dropped after the imposition of the surcharge, indicating that foreign producers are at least temporarily absorbing that surcharge so as to avoid a loss of markets. This is likely to persist into the longer run.

The price freeze will probably have little effect on the lead industry, as the price of lead has declined substantially from the $0.165 per pound prevailing on May 25, 1970 and which represents the permitted ceiling. As calculated in Chapter 6 of this report, there is room for a 17 percent price rise above the October level, should producers feel that market or changed cost conditions warranted it.

There are about 1.124 million tons of lead in the strategic stockpile. In October 1971, GSA declared that 575,000 tons of lead were in excess of the stockpile target. Letters of agreement have been signed by all U.S. primary lead producers and GSA, providing for annual producer purchase from the stockpile of up to 50,000 tons of lead. Amounts are to be allocated to individual smelters according to their 1970 production, subject to review every three years. Terms of sale are to be negotiated with individual producers to adjust the published price for reworking, handling, and distribution costs. It is expected that arrangements will be completed in time for Congress to authorize sales in 1972. Because of the high level of producer stocks of lead, it is possible that stockpile releases will be postponed for 1972. Eventual release is not likely to affect the price of lead.

The Lead Industry in the United States

There are three lead mining regions in the United States, distinguished by the recoverable metal of major value in the regional ore: lead ores, lead-zinc ores, zinc ores and all other ores from which some lead is obtained. In the eastern states, ores are primarily in the zinc category, with lead being mined as a by-product. Lead ores in the central states are of the

lead type, and in the western states lead-zinc and more complicated ores are predominant. Lead or lead-type ores, located primarily in Missouri, are the source of about two-thirds of domestic ore production.

Although some 20 states are engaged in lead mining activity, four states are clearly dominant. In 1970, Missouri supplied nearly 75 percent of U.S. ore production, followed by Idaho with 10 percent, Utah with 7.6 percent, and Colorado with 3.5 percent. The major U.S. mining companies, in terms of share of U.S. mine output, are St. Joe Minerals Corporation, Missouri Lead Operating Company, Cominco American, Ozark Lead, and Bunker Hill. Only Bunker Hill of Idaho is not located in Missouri.

There is a definite trend in Missouri's growing importance in the lead mining industry. More than 75 percent of the ore produced from Missouri mines in 1969 came from mines that have been opened since 1960. The physical characteristics of these newly worked deposits permit the use of highly mechanized equipment and automated processes on a large scale, resulting in labor efficiencies and metal recovery substantially above those of other mining areas. These capital intensive, low cost ore removal methods are more important than ore grade in giving the new Missouri mines a cost advantage over the typical mines of Idaho, Utah, Colorado and other states.

Ores from domestic mines provided domestic refineries with about 83 percent of 1970 requirements the remainder being imported. Thus the lead industry is considerably less dependent upon foreign ores than is the zinc industry, which imports about 50 percent of its ores.

PRODUCTION OF SOME LARGE U.S. LEAD MINERS
(PERCENT OF TOTAL U.S. LEAD MINE PRODUCTION)

Company	1962	1966	1970
St. Joe Minerals Corporation	25.9	40.6	36.7[1]
ASARCO	3.1	2.2	0.9
Bunker Hill	19.6	10.4	5.5
Eagle Picher	1.7	1.5	0.4
Hecla	10.9	9.3	4.7
Cominco American*	--	--	8.6
Ozark Lead (Subsidiary of Kennecott)*	--	--	7.8
Missouri Lead Operating Company (Subsidiary of Amax)*	--	--	12.1

SOURCE: ABMS *Yearbook*, 1970 and 1966 for all figures except those marked by an asterisk, which are estimates for new Missouri mine output based on information contained in the following sources: "Lead and the Missouri Boom," *Compressed Air Magazine*, January 1967; U.S. Bureau of Mines *Minerals Yearbook*, 1968 and 1969.

[1]St. Joe's share in 1970 seems to be unrepresentative of that company's growing importance in the industry. Its 1969 share was 47.7 percent, and unusual circumstances appear to have affected its 1970 production performance.

Of the mining companies listed above, it appears that those operating primarily in Missouri have the lowest cost operations. The major producers of refined lead whose smelters draw upon these Missouri mines will be characterized as comprising the low-cost sector of the industry.

There are six major primary lead refining companies which produce essentially all of the domestic primary refined lead, and two of these companies treat all of the imported ores and concentrates.

PRODUCTION OF SOME LARGE U.S. LEAD REFINERS

(Percent of Primary & Secondary Lead Refined in the U.S.)

Company	1962	1966	1970
AMAX-Homestake Lead Tollers	--	--	14.6
ASARCO	40.2	38.1	28.6
Bunker Hill	19.0	19.0	15.6
International Smelting & Refining	1.8	2.7	1.5
St. Joe Minerals Corporation	15.6	19.8	26.1
U.S. Smelting Refining & Mining	7.0	6.7	3.8

SOURCE: ABMS *Yearbooks*, 1966 and 1970.

These six companies operate seven smelters. The AMAX and St. Joe smelters are located in Missouri, and each has an accompanying sulfuric acid plant. Bunker Hill's Idaho smelter also has an acid plant. ASARCO's smelters are located in Texas, Montana, and Missouri. The International Smelting and Refining Company operates a smelter in Utah, which is scheduled to be closed in December, 1971. Most of the companies engaged in lead refining have extensive operations in other activities, with net sales and annual capital expenditures each ranging from $60 to $110 million. Two companies are considerably smaller and less diverse in their activities. Profits as measured by net income as a percent of equity ranged from about 5 to 16 percent in 1970.

The seven domestic primary lead smelters, soon to be six, can be categorized according to high and low production costs. The dominating factor determining a smelter's placement in the low-cost category is access to low-cost ores. The three Missouri smelters share this advantage, as well as that of good waterway transportation. As most Missouri lead is obtainable at

roughly the same cost, and as smelter technology does not vary widely among plants, the chief difference among the three low-cost producers is probably pollution control costs. These are likely to be lower for the two smelters in this category which currently operate acid plants. The chief difference among high-cost producers is evidently the availability of low-cost ores and transportation, although one high-cost producer may have lower pollution control costs than others within this category.

An examination of costs and profits in the lead industry indicates that the low-cost producers have experienced significant declines in real average costs and have a substantial cost advantage over high-cost producers. It also appears that the excess of price over cost for the low-cost producers is amply sufficient to bid competitively with the rest of the economy for new capital. This does not appear to be the case for high-cost producers.

Chapter 7 of this report contains specific detail on the issues outlined above.

The production side of the secondary metal market is characterized by relatively easy entry, low concentration, and a cost structure substantially different from that of primary producers. The scale of operations of a secondary producer is typically very small relative to that of a primary producer. The secondary producers are the chief sources of antimonial lead and practically the exclusive source of other lead alloy output. They produce only about 25 percent of all domestic refined lead.

The Bureau of Mines *Minerals Yearbook* noted that nearly 150 plants reported some secondary production in 1969, and the 1970 ABMS *Yearbook* listed 32 companies engaged in secondary smelting and refining.

The Economic Effects of Pollution Control on the Lead Market

The Environmental Protection Agency has proposed standards governing both the emission into the air of sulfur dioxide from lead smelters and the discharge of wastes into water sources. In addition, the EPA has estimated the costs of installing control equipment to meet these standards.

Pollution Control Costs

Table 8-1, from Chapter 8 of this report,[1] presents data provided by the Council on Environmental Quality showing costs that would have to be incurred by lead smelters to attain the standard of 90 percent removal of feed sulfur. Table 8-2 presents data for water pollution control costs. Table 8-3 presents the combined annual costs estimated for 1976. These can be regarded as the level of costs persisting in the long run after full installation of the required pollution abatement equipment and which will affect the producers' profit rates.

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[1]Table 8-1, 8-2, and 8-3 are reproduced here for convenience.

Table 8-1

COSTS OF CONTROLLING SULPHUR DIOXIDE EMISSIONS
AT PRIMARY LEAD SMELTERS, RELATIVE TO THE STANDARD OF
90 PERCENT REMOVAL OF FEED SULPHUR
(Millions of August 1971 Dollars)

	1972	1973	1974	1975	1976
Investment Outlays					
Existing Facilities	3.25	6.50	22.75	26.00	6.50
Annual Costs					
Operation & Maintenance	0.40	1.21	4.03	7.25	8.06
Interest	0.33	0.98	3.26	5.86	6.51
Depreciation	0.22	0.68	2.27	4.08	4.55
Total	0.95	2.87	9.56	17.19	19.12
"Total" Costs					
Total Cash Costs[1]	3.98	8.69	30.04	39.11	21.07
Total Direct Costs[2]					

[1]Investment costs plus annual costs minus depreciation.

[2]Total cash costs minus interest.

SOURCE: Council on Environmental Quality.

ASSUMPTIONS:
(1) An acid plant whose entering gas stream is cleaned is the proposed control method.

(2) The interest rate is 10 percent.

(3) The growth rate of production from existing capacity is 1.4 percent per year.

(4) The depreication rate is 7 percent per year.

(5) No downtime for installation is envisaged.

(6) A smelter model of zero current control, producing 47,000 tons of lead per year and operating at full capacity for 330 days a year, was used for the cost calculations.

(7) The SO_2 concentration of the gas stream entering the acid plant is assumed to be 5 percent.

(8) Five lead smelters were assumed to require control.

Table 8-2

COSTS OF WATER POLLUTION CONTROL FOR THE LEAD AND ZINC INDUSTRY COMBINED, RELATIVE TO THE STANDARD OF EQUIVALENT OF SECONDARY TREATMENT

(Millions of August 1971 Dollars)

	1972	1973	1974	1975	1976
Investment Outlays					
Existing Facilities	1.557	1.629	1.703	1.775	1.848
New Facilities	0.231	0.235	0.240	0.245	0.250
Total	1.788	1.864	1.943	2.020	1.098
Annual Costs					
Operation & Maintenance	0.204	0.411	0.617	0.823	1.030
Interest	0.115	0.231	0.347	0.463	0.580
Depreciation	0.071	0.143	0.217	0.289	0.362
Total	0.340	0.785	1.181	1.575	1.972
"Total" Costs					
Total Cash[1]	2.107	2.506	2.907	3.306	3.703
Total Direct[2]	1.492	2.275	2.560	2.843	3.123

[1] Investment costs plus annual cost. minus depreciation.
[2] Total cash costs minus interest.

SOURCE: Council on Environmental Quality

ASSUMPTIONS:
(1) Lead and Zinc smelters would apply coagulation, sedimentation, and neutralization to 100 percent of process wastewater.
(2) The interest rate is 8 percent.
(3) The growth rate of lead production is 1.4 percent and that of zinc production is 2.2 percent per year.
(4) The depreciation rate is 5 percent per year.
(5) Some downtime for installation is included.

Table 8-3

ANNUAL COSTS OF SULPHUR DIOXIDE EMISSION
AND WATER POLLUTION CONTROL
AT PRIMARY LEAD SMELTERS IN 1976

U.S. Production[2] (Tons)	Total Annual Abatement Costs ($ Million)	Middle Estimate of Abatement Cost Per Pound	Low Cost Estimate[3]	High Cost Estimate[4]
726,500	20.18	$0.014	$0.012	$0.017

[1]The annual costs of water pollution control are given for the combined lead and zinc industries. The figures in this table are based on the arbitrary allocation of half that combined figure to lead and half to zinc.

[2]The CEQ's estimated growth rate of lead -- 1.4 percent per year -- is applied arithmetically to 1970 U.S. lead coutput of 670,000 tons to yield the figure of 726,000 for output in 1976. The 1976 figure appears quite reasonable in light of our own studies of this market.

[3]The high and low cost estimates allowed the minus 10 to plus 25 percent error for air pollution control costs, and no error for water pollution control costs.

SOURCE: Tables 1 and 2.

Effect of Pollution Controls on the Lead Industry

In the absence of pollution control costs, U.S. lead consumption can be expected to continue its long-term growth rate of slightly more than 1 percent per year. The growth will occur primarily in the battery market, which accounts for about 40 percent of domestic lead consumption. The tetraethyl market is a source of uncertainty, as the question of pollution control devices for automotive emissions has not been settled. It appears reasonable to expect approximately a 40 percent loss of this market by about 1975 as the net result of new cars using lead-free gasoline, reduced lead content of regular grade gasoline, and probable state regulations. Thereafter it is generally expected that further reductions of 10 percent per year will occur. This will depress the growth rate of consumption until about 1980, when the long-term rate is likely to be regained, but will have no effects on production costs of lead producers. The total consumption trend is not likely to be altered by the imposition of pollution control costs, for two reasons. The first is that demand for lead is very insensitive to price changes. Secondly, the price changes that can be expected to follow the pollution cost increases is very small.

The major trends on the supply side of the lead market are a replacement of older mines and the smelters that drew upon them for concentrates by newer mines and the smelters that process their ores, and an increase in market concentration. The major force behind this rearrangement is the discovery and development of extensive ore deposits in Missouri, which have relatively

low mining costs and which are favorably situated with respect to transportation. These trends form an important part of the basis for our segmentation of the domestic primary lead industry into high- and low-cost producers. This development has also been largely responsible for an additional change in the supply picture -- a reduction in the share of imports in U.S. lead consumption. The major impact of abatement costs will be to accelerate the trend of reallocating domestic supply from high- to low-cost producers, and perhaps to retard somewhat the trend toward a lower share of imports in U.S. consumption.

The price of lead is likely to remain constant or decline in real terms in the absence of abatement costs, due to similar trends in costs. The effects of abatement costs on price will depend importantly upon their incidence on high- and low-cost producers. It seems likely that the abatement costs will fall much more heavily upon the high-cost producers, in which case it is likely that no price increase will occur. In the less likely event that abatement costs fall equally upon low- and high-cost producers, some small price rise can be expected, limited by foreign competition and accompanied in the long run by a retardation in the trend towards a lower share of imports in U.S. consumption.

In the absence of abatement costs, there will probably be a continuation of the trend toward less employment in mining and smelting. The impetus for this decline arises both from increased mechanization and automation through all stages of production and from the fact that the newer Missouri mining operations are less labor

intensive than the older mining operations. The effect of abatement costs will be to accelerate the decline of employment in the high-cost sector. This is likely to have more severe impacts in the areas of Montana and Idaho, which are rural and undiversified, than in Texas.

As the high-cost sector depends to a considerable extent on imported ores, the relative decline of this sector will to a small degree offset the effects of increased lead metal imports. Because the expected price increase resulting from abatement costs is small, there will be only small increases in metal imports. As the expected cost increase is less than transportation and tariff costs for imports, there is likely to be no incentive to relocate smelters abroad. Thus the net balance of payments impact is likely to be small.

This is one of four reports prepared by
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